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ABSTRACT

The Collaborative Vision for Science and Mathematics Education (CVSME) is a loosely coupled organization that has improved communication and fostered collaboration between faculty in the colleges of Education and Natural Science at Michigan State University. The improved communication and collaboration is intended to improve mathematics and science teaching and learning from kindergarten through graduate school. The paper briefly describes the history of the organization, some of its accomplishments, and identifies characteristics that have both fostered and frustrated the collaborative work. (Author/CCM)

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A Brief History of the Collaborative Vision for Science and Mathematics Education at Michigan State University

by
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A BRIEF HISTORY OF THE COLLABORATIVE VISION FOR SCIENCE & MATHEMATICS EDUCATION AT MICHIGAN STATE UNIVERSITY

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The Collaborative Vision for Science & Mathematics Education (CVSME) is a loosely coupled organization that has improved communication and fostered collaboration among faculty in the Colleges of Education and Natural Science. The improved communication and collaboration is intended to improve mathematics and science teaching and learning from kindergarten through graduate school. We believe we are making strides towards these goals. This paper will briefly describe the history of the organization, some of its accomplishments, and identify characteristics that have both fostered and frustrated the collaborative work.

Precursors

Program Structures

Several factors preceded the formal establishment of this collaborative. There is a respected, long-standing and sizable science education faculty group in the College of Education. Every fall, virtually all of the science education faculty and graduate students participate in weekly seminars, and in the last two years, a small number of faculty from the College of Natural Science have joined these seminars. The theme of this course, Teacher Education 955, changes from year to year. In 1998, the focus was on the differences in culture between the two colleges.

Under the leadership of Clarence Suelter, The Division of Science and Mathematics (commonly referred to as "The Division") formed within the College of Natural Science serving as a point of contact for the College of Education. For the last two and a half years, The Division has been under the leadership of Jim Miller. In 1999, Joan Ferrini-Mundy will assume the directorship of The Division. The Division is the formal structure in which masters' degree programs for practicing science teachers are housed. The Division also includes two faculty, one tenure stream

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and one temporary, with joint appointments in the two colleges. Several other faculty and support staff serve bridging roles between the two colleges.

A Catalyst for Collaboration

In the Fall of 1994, Michigan State University hosted a meeting to review an early draft of Project 2061's *Blueprint for Science Literacy*, involving scientists and science educators from around the country. At that meeting, there was a heated exchange between physicist Dan Stump and science educator Tim Smith, both (unbeknownst to each other) of MSU.

Tim found the conversation worth continuing and talked further to Dan and discovered they were both from MSU. As a result of this conversation, Tim established the Science Education Brown Bag Lunch Group. This group has continued to meet regularly since 1994. The setting is always informal, sometimes without an established agenda, but usually focused around a particular reading or issue. Attendance typically varies between ten and twenty, and both colleges are always represented. Beginning in the fall of 1998, mathematicians and math educators with interests in issues affecting both mathematics and science education have joined the conversations.

Beginnings of CVSME

In 1996, College of Education Dean Carole Ames launched an initiative to fund several "themes" within the college. These themes were intended to foster "intellectual communities" within the College of Education and internal funding was available. This served as a catalyst for conversation among the science education faculty group, encouraged by Ed Smith. Continued conversation lead to the inclusion of mathematics within the "theme" proposal and to branching across the two colleges. An organizational meeting was held that lead to the writing of the internal proposal. Funding of $8,000/year was awarded beginning in January of 1997. This funding was used to hire Don Duggan-Haas as the project's graduate assistant. Funding also was used for large group meetings, the most recent of which was January 7, 1999.

A steering committee formed including a scientist, science educators, a mathematician, and math educators. The Steering Committee meets monthly while whole group meetings have

typically taken place once a semester. These whole group meetings have lead to additional meetings of smaller groups, including those involved in substantial grant development activities (see below for information regarding accomplishments).

Following the first meeting, website development began as one vehicle for information dissemination. A listserv was also established now including over forty subscribers from the two colleges, the Michigan Department of Education and directors of the state's Math and Science Center Network. Both the website and the list have continued to slowly grow over the last two years. Much more information about CVSME and related projects and activities is available on the website at <http://ed-web3.educ.msu.edu/cvsme>.

Figure 1. The Aims of CVSME

What is The Collaborative Vision for Science & Mathematics Education?

The Collaborative Vision for Science and Mathematics Education is a new and unique group at Michigan State University. CVSME seeks to improve science and mathematics teaching at all levels. Begun under an initiative of the Dean in the College of Education, this group has received strong support from the College of Natural Science, and encompasses most of the research faculty in science and mathematics education in the two colleges. The current participants number more than forty and include staff members from the Michigan Department of Education.
The aims of this group include:

- Creating new images of what science and mathematics education might be
- Providing a forum for consideration of needs and priorities for work in science and math education, i.e., strategic planning
- Informing our faculty better of one another's work and of relevant developments at the national, state, regional and local levels
- Facilitating preparation of collaborative projects that interrelate multiple aspects of our work
- Communicating the scope and impact of our combined efforts to administrators and policy makers
- Focusing of institutional support for major proposals
- Providing an access point for queries, expressions of concern or proposals about science and math education
- Providing a more informed, timely, and effective voice on policy matters that arise
- Fostering an intellectual community for faculty and advanced graduate students

This group is in a position to work with others around the University in strategic planning for new and continuing initiatives.

The opening text of CVSME's website defines the aims of the organization. This is shown in Figure 1. The text was written in the spring of 1997, shortly after the first meeting. In the following pages, the success of CVSME in meeting these goals will be addressed.

CVSME's second meeting lead to the creation of two foci -- one targeting the improvement of K-12 teaching and learning in schools hosting MSU's teacher candidates field placements (Alliance Schools) and the second targeting the improvement of undergraduate teaching and learning in mathematics and science at MSU. Several smaller meetings followed for each of the two foci, leading to important collaborations in both areas. A small ($30,000) NASA NOVA Grant was awarded to reform non-majors biology classes. More information about this work can be found at <http://ed-web3.educ.msu.edu/cvsme/nova.htm>.

In 1998, several important projects with direct ties to CVSME were initiated. In the Spring of 1998, CVSME hosted its first colloquia, with Dr. Gerd Kortemeyer discussing the Learning OnLine project. This project involves using the World Wide Web for undergraduate science course content delivery. This colloquium also marked CVSME's entree into educational technology, the focus of the January 7, 1999 meeting.

Throughout the spring of 1998, a large grant writing team involving faculty, post doctoral fellows and graduates students from the Colleges of Natural Science and Education developed a Howard Hughes Medical Institute Grant proposal. A $1.6 million award was announced in the summer and work is underway ① to reform introductory biology courses for science majors, ② to expand opportunities for undergraduate research and ③ to expand faculty professional development programs. Information about this project can be found at <http://lecture.lite.msu.edu/~hughes/>.

Jane Rice, of the College of Natural Science, developed a physical science course for elementary teacher candidates that was taught in the fall of 1998. Throughout the course, she worked closely with science educators. The course is being taught again in the spring of 1999, and enrollment is full.

In the Fall of 1998, the scope of educational technology projects in the College of Education were largely unknown to CVSME participants. This came to light as a result of Steering

Committee meetings and meetings involving Ed Smith, Jim Miller and Don Duggan-Haas, and, eventually, faculty and educational specialists directly involved in educational technology. This lead to the January 7, 1999 meeting entitled, "Using Technology in Support of Science & Mathematics Education."

This meeting helped faculty involved in both science and science education understand the scope of educational technology projects underway in both colleges and to see how their work might support these efforts and to discuss new possibilities for collaborative efforts. As a result of this meeting, at least two significant new grant writing teams have formed.

An Overview of CVSME's Accomplishments

Although many factors are involved in the strengthening collaboration between educators and scientists at MSU, we believe that CVSME played an integral role in several major accomplishments. These include:

- A general improvement in awareness of projects and programs in the two colleges related to science and mathematics education. This is perhaps our most important success. Communication has improved through both formal and informal channels. CVSME's listserv, website and meetings have served as formal channels for the dissemination of information and have acted as catalysts for more informal channels.
- A recently awarded Howard Hughes Institute Grant for reconceptualizing the science majors' introductory biology course and to expand opportunities for undergraduate research. Course improvements will include reforming pedagogy and the increased use of multimedia in course instruction. The award amount is 1.6 million dollars.
- The development of The Division of Science and Mathematics Education's Educational Principles. The Educational Principles are posted on the Division's website at: <http://www.dsme.msu.edu/challenges.htm>, with some further explanatory text. These principles are intended to inform the teaching in college science classes with educational research.

- A new course for elementary science teacher candidates, developed by a scientist in collaboration with science educators.
- A substantial and growing website that offers a central location for information sharing related to science and mathematics teaching and learning from pre-school through graduate school. The URL is: <http://ed-web3.educ.msu.edu/cvsme>. The site includes descriptions of, and links to, projects and programs which involve university faculty and graduate students that are related science and mathematics teaching and learning. The projects included are a representative sample, not an exhaustive list.
- A listserv with approximately fifty subscribers where information relevant to science and mathematics education is shared within the university community. The listserv also provides a vehicle for the dissemination of an electronic newsletter, The CVSME Update. The newsletter is also archived on the website.
- A NASA funded NOVA grant that is intended to improve teaching and learning in a non-majors' biology class.
- CVSME sponsored colloquia related to the teaching and learning of science and mathematics that have been well attended by faculty from both the College of Education and the College of Natural Science.

All of the above were the result of scientists and science educators working together. CVSME helped provide avenues for these collaborations. The authors believe that there are lessons to be learned from the work of The Collaborative Vision for Science and Mathematics Education that are transferable to many institutions. The divide between scientists and science educators is nearly universal and the demand for reform of tertiary-level teaching is growing. CVSME is an appropriate response to these conditions that may offer a model for others to adapt to their own situations.

Table 1 lists websites that include more information on several of the projects related to CVSME. All of the listed URLs are included within CVSME's site. This is a partial list of URLs

for projects and programs related to CVSME. All links below and many more may be found within the CVSME website.

Table 1.

Websites related to The Collaborative Vision for Science & Mathematics Education	
Collaborative Vision for Science & Mathematics Education	http://ed-web3.educ.msu.edu/cvsme/
The Division of Science & Mathematics Education	http://www.dsme.msu.edu/
Michigan State University On Line Curriculum and Research Scholars (Howard Hughes Medical Institute grant project)	http://lecture.lite.msu.edu/~hughes/
The NOVA Project -- Implementing Innovative Teaching of Science at Michigan State University Using Integrative Studies Courses as a Springboard	http://ed-web3.educ.msu.edu/cvsme/nova.htm
The Division's Educational Principles	http://www.dsme.msu.edu/challenges.htm
The College of Education	http://www.educ.msu.edu/
The College of Natural Science	http://www.ns.msu.edu/
Michigan State University	http://www.msu.edu/

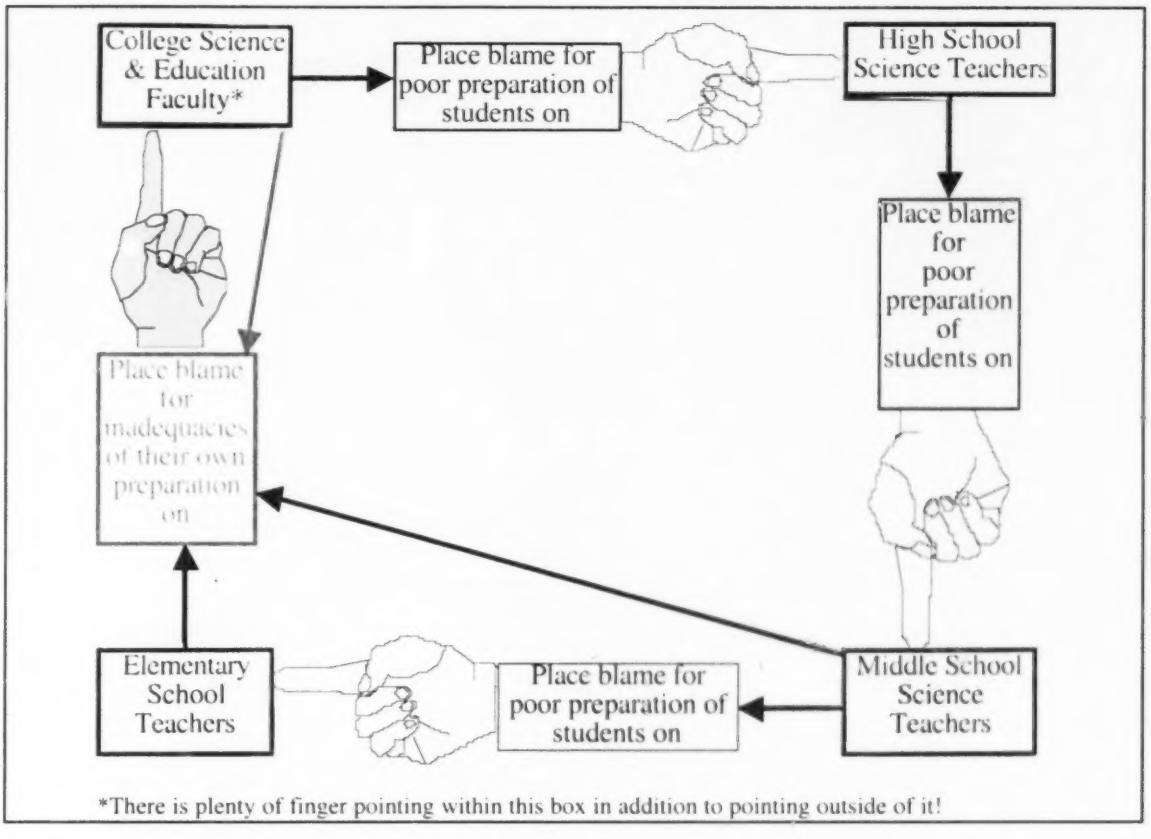
Obstacles Faced Along the Way

It is generally accepted that science education K-16 has serious problems in this country. Blame is placed in a variety of settings and when these arguments are viewed collectively, the 'blame path' is circular. College faculty despair about the quality of the pre-college preparation of their students (Seymour & Hewitt, 1997). High school teachers blame middle school teachers; middle school teachers blame elementary school teachers and elementary school teachers blame poor teaching in college for their lack of content knowledge (McDermott 1990). In addition to these links, all of the individuals included have been trained in college or university to do their current work, so blame may be pointed to college science preparation from anywhere within the cycle. This includes the college science professors themselves who have generally not seen consistently good models of teaching in their own professional preparation. (See Figure 2.)

Figure 2 shows one possible, "cycle of blame," for the problems of science teaching at many levels. The gray lines from college faculty back to college faculty is perhaps the least

obvious and most important. Through this reflective arrow real change maybe generated. Of course this, of course, is a simplified model. What is the role of family? Of culture?

Figure 2. Cycle of Blame


College Science & Education Faculty*
Place blame for poor preparation of students on
High School Science Teachers
Place blame for poor preparation of students on
Place blame for inadequacies of their own preparation on
Elementary School Teachers
Place blame for poor preparation of students on
Middle School Science Teachers
*There is plenty of finger pointing within this box in addition to pointing outside of it!

Most salient to members of this collaborative is the finger-pointing within the box in the upper left hand corner of Figure 2 (this is not pictured). There is a fair amount of blame being assigned by both sets of academics both nationally and at MSU. This is perhaps the greatest obstacle we face.

Teachers at all levels must not simply respond to problems in teaching with statements beginning, "If only…" but must instead think in terms of, "If I…" or "If we…" (Fullan 1991). In other words, faculty must assume responsibility rather than place blame. Our discussions, particularly those in the Brown Bag Lunch group and in the Steering Committee, have generally moved beyond blaming. Those who are regular participants still engage in heated conversation, but

they also recognize that other participants in the conversation have expertise that is valuable to the conversation and that all members of the conversation care deeply about teaching and learning.

This progress has been more noticeable in science than in mathematics, at least for undergraduate teaching. Sadly, the most outspoken member of the mathematics department representing CVSME and the only mathematician on the Steering Committee, Bill Fitzgerald, passed away in 1998. We have been unable to find a mathematician to take his place on the committee.

Many of the problems faced can be better understood if it recognized that there are huge cultural differences between the two colleges. There is a divide between the two cultures, similar to the one described by C.P. Snow (1959). These two cultures are defined by, and maintained through, the nature of interactions academics have with each other and with their students in each college. The differences perceived by students are delineated in Table 2.

It is not surprising that students see little relationship between their science and TE course work. It seems that every instructional characteristic of one program is reversed in the other. Unless otherwise noted, quotations are taken from New Teacher Interviews of MSU graduates. This table represents data from the Salish I Project and is adapted from (Duggan-Haas 1998).

The cultural divide is easily recognized by faculty in either college. There is plentiful anecdotal evidence of the divide, and less evidence on initiatives to narrow the divide. For example, the conversation between Tim Smith and Dan Stump that acted as a catalyst for the Brown Bag Lunch series highlighted the divide. Their work together over the four years since that discussion, and their work in other border-crossing activities indicates that the gap is being closed for these two individuals. Tim has been involved in the grant writing team for the successful grant proposal to Howard Hughes Medical Institute. He drafted what became the Educational Principles of The Division of Science and Mathematics Education as part of his work on the proposal. Dan has been involved in a science curriculum committee for a local district and in other curriculum development. Both have been regulars at the BBL gatherings for four years.

Table 2. New science teacher perceptions of teacher education and science coursework

Characteristic	Science	Teacher Education
Course Instruction	Lecture, "...mostly lecture. Not much labs, not great labs when we had them."	Group work/discussion, "I would say a little bit of everything besides lecture."
use of lecture	embrace	shun
use of cooperative learning	shun	embrace
class-size	large	small
Program purpose/goals	Goals are well-defined and understood: content; to learn facts	Goals are poorly defined or understood. Many different goals are identified.
textbook use	embrace	shun
Instructional Resources	Textbook	Readings — collections of articles
Methods of assessment	objective tests, mostly multiple-choice	written work before the internship, written work along with teaching performance during the internship.
Teacher-Student relationships	"By far, the commonest words used to describe encounters with S.M.E. [science, mathematics and engineering] faculty are 'unapproachable,' 'cold,' unavailable,' 'aloof,' indifferent,' and 'intimidating.'" (Seymour & Hewitt, p. 141)	personal; "Excellent," was a term used by half the participants to describe the faculty-student relationship in the Salish study.
Program components valued by new teachers	Research or research like experiences – two new teachers graduated from MSU reported such experiences; one as a volunteer, the other at a different institution. In most cases, these experiences were outside the formal program.	The full-year internship; the sequence of courses in TE related to their subject matter. In all cases, these experiences were part of the formal program.
Partial Summary		
Classroom culture's relation to professional work	Undergraduate science courses do not generally reflect the work of scientists. Unfortunately, they may reflect the work of science teachers.	Undergraduate teacher education courses reflect what teachers should do (in the opinion of teacher education faculty) in their own classrooms.

What makes CVSME work (if it does)?

The system that is science and mathematics education is a complex adaptive system. Identifying the essential elements leading to this collaborative is an impossible task. Several initiatives came together at the same time that seemed to facilitate more pieces fitting together.

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Perhaps this is what E.O. Wilson means by consilience, a jumping together of several factors. Perhaps it is synergy. While we have made progress, what lies ahead is a far greater challenge.

How can we measure our success? The aims established for CVSME (see Figure 1) are listed below. Each aim from Figure 1 (*italicized* below) is followed by a brief explanation of where CVSME stands in relation to that aim.

Creating new images of what science and mathematics education might be

This is perhaps best demonstrated through the work surrounding the January 7, 1999 meeting entitled, "Using Technology in Support of Science & Mathematics Education." This meeting focused on the thoughtful, pedagogic use of technology in K-12 mathematics and science education. The meeting and the work both before and after the meeting has fostered discussion and collaboration between and among faculty involved in discipline specific work with those involved in educational technology. Increased clarity of what integration of technology into science and math at MSU might look like and how collaborative efforts might focused. In fact, concrete steps, including two proposals for new collaboratives, have been submitted.

Providing a forum for consideration of needs and priorities for work in science and math education, i.e., strategic planning

By strategic planning, we mean that projects are coordinated with each other and moving toward common goals. The two foci of CVSME explain our targets for reform – teaching and learning of science and mathematics for undergraduates at MSU (Focus 1) and teaching and learning of science and mathematics in schools hosting MSU teacher candidates (Focus 2). Strategic planning related to Focus 1 includes the development of grant proposals, such as the Howard Hughes Medical Institute (HHMI) grant funded for $1.6 million. The January 7, 1999 meeting is one example of such a forum for Focus 2. It also includes work within the teacher preparation program, which is expected to be the focus of a spring 1999 meeting.

Informing our faculty better of one another's work and of relevant developments at the national, state, regional and local levels

This is perhaps CVSME's greatest success. Through formal and informal meetings, the website and the listserv, faculty are far more aware of each others' work and are finding connections within each others' work. This is true not only between the colleges, but also within the colleges. We have found projects of which even faculty with related interests within the same college were not aware. Relevant projects and programs from other units, for example, the Office of Computing and Technology, have been able to communicate to faculty through these avenues. Additionally, the listserv and lunch group meeting have provided a forum for discussion of related issues at the state and national levels.

Facilitating preparation of collaborative projects that interrelate multiple aspects of our work

The HHMI grant is a very important collaborative project for both colleges and for our students. While this is not a direct outgrowth of CVSME, more recent proposals are a direct result. This includes proposals for a Technology Literacy Challenge Fund Grant proposal and a Rural Systemic Initiative grant proposal.

Communicating the scope and impact of our combined efforts to administrators and policy makers

The Dean's of both Colleges have attended CVSME meetings and funding continues from the Dean of the College of Education's office. The provost's office was involved in the HHMI proposal and is involved in the ongoing work related to the grant. Representatives from the Michigan Department of Education have been involved with CVSME through both electronic communication and participation in meetings. These are all indicators that the work of CVSME is valued by administrators and policy makers.

Focusing of institutional support for major proposals

Again, the HHMI grant and other proposals either recently submitted or under development have found CVSME's meetings and electronic communication avenues useful for proposal

development. There is also an effort underway seeking Title II funds directed by Associate Dean of the College of Education, Robert Floden and involving faculty from both colleges.

Providing an access point for queries, expressions of concern or proposals about science and math education

It is clear that the listserv provides such an access point. Individuals from Michigan Department of Education, various mathematics and science centers in Mid-Michigan and other from outside the university have joined in both electronic and face-to-face communication through CVSME. Additionally, faculty and graduate students outside of the College of Education have been continually subscribing to the listserv. However, this access point has not been used to its full potential. It has served primarily to send information out rather than to respond to queries.

Providing a more informed, timely, and effective voice on policy matters that arise

Although the membership of CVSME has not seized every opportunity to speak to policy issues, it has, though the steering committee, endorsed the recruitment efforts for a new director of the Division and for implementation of Jane Rice's course. Also, important groundwork has been laid for playing roles in future policy work. This groundwork takes multiple forms – the very existence of CVSME, the electronic communications possible through the listserv and website and through steering committee and other meetings.

Fostering an intellectual community for faculty and advanced graduate students

The opportunities provided for open discussion and collaborative work have helped to foster the intellectual community that sits between the Colleges of Education and Natural Science. This includes discussions in the Brown Bag Lunch Group around critiques of national standards, state Science Education Frameworks and, more generally, about the nature of science.

CVSME has made considerable progress towards its goals. While it is difficult to determine what is causal in regards to this progress, we believe that CVSME has offered many avenues towards their fulfillment.

What elements have helped us towards our successes? This confluence of individual and administrative initiatives -- the Brown Bag Lunch Group coming together before the Dean of Education's "Theme Initiative," and Ed Smith's and Jim Miller's perseverance for several related initiatives to see themselves as related are all important pieces of the puzzle. There is also a broader stick-to-itiveness, what M. Scott Peck refers to as a willingness to "work through the chaos." (Peck 1998). Where there has been success, there has also been a willingness to work with colleagues that see the world in a different way and a willingness to listen and respect views other than our own.

For the past two years, we have worked to improve communication and collaboration among our colleagues. We are now beginning to study our work towards these goals. Our work has also lead to an important new goal -- to more directly connect the work in educational technology at MSU to work in science and mathematics education.

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